Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Expanding Access to Broadband and	)	GN Docket No. 13-114
Encouraging Innovation through Establishment	)	RM-11640
of an Air-Ground Mobile Broadband	)	
Secondary Service for Passengers Aboard	)	
Aircraft in the 14.0-14.5 GHz Band	)	

REPLY COMMENTS OF THE SATELLITE INDUSTRY ASSOCIATION

The Satellite Industry Association ("SIA") hereby submits these reply comments in response to the Notice of Proposed Rulemaking ("NPRM") in the above-referenced proceeding, which seeks to implement a proposal by Qualcomm Incorporated ("Qualcomm") to add a secondary allocation and establish new Federal Communications Commission ("FCC" or "Commission") rules for an Aeronautical Mobile Service ("AMS") in the 14.0-14.5 GHz band to provide air-ground mobile broadband service.[1]

The record to date in this proceeding reflects broad consensus on the need to protect the primary fixed-satellite service ("FSS") in the 14.0-14.5 GHz band—both geostationary and non-geostationary—from any new secondary AMS that the Commission may decide to introduce in this band.[2] As SIA and other parties have demonstrated, the protection rules proposed in the

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[1] *Expanding Access to Broadband and Encouraging Innovation through Establishment of an Air-Ground Mobile Broadband Secondary Service for Passengers Aboard Aircraft in the 14.0-14.5 GHz Band*, Notice of Proposed Rulemaking, 28 FCC Rcd 6765 (2013) ("NPRM").

[2] *See, e.g.*, EchoStar Satellite Operating Corporation and Hughes Network Systems, LLC (collectively, "EchoStar") Comments at 3-4; National Association of Broadcasters ("NAB") Comments at 2-3; Telecommunications Industry Association ("TIA") Comments at 4; United Airlines, Inc. ("United") Comments at 2, 7-8; ViaSat, Inc. ("ViaSat") Comments at 3; Gogo Inc. ("Gogo") Comments at 16; Qualcomm Comments at 8-9 (unless otherwise indicated all comments are filed in GN Docket No. 13-114).

NPRM are inadequate, and further steps must be taken to ensure that there are specific and enforceable rules for the protection of the FSS.[3]

Interference Protection Standard for GSO and NGSO FSS. SIA agrees that the 1% ΔT/T standard specified in ITU Recommendation S.1432 is the correct starting point for developing rules to protect primary FSS uplinks from non-primary sources of interference. However, the ITU Recommendation specifies 1% ΔT/T as the allowable interference from *all* non-primary sources into the primary FSS—not the interference from any single non-primary service. As a result, it would be inappropriate to allocate the entire 1% to a new secondary AMS given that there are other non-primary allocations in the 14.0-14.5 GHz band. These include federal allocations for space research in 14.0-14.2 GHz, and for fixed and mobile services in 14.4-14.5 GHz. Moreover, the Commission must consider the possibility of future non-primary allocations in the United States or in neighboring countries, especially when a number of Ku-band FSS satellites serving the United States have beams that cover all of North America. For these reasons, SIA has proposed that the secondary AMS be allowed to contribute no more than a 0.33% ΔT/T into primary FSS uplinks—for both geostationary ("GSO") and non-geostationary ("NGSO") systems—to ensure that the 1% ΔT/T standard is not exceeded in the aggregate.[4]

By the same token, Qualcomm's proposal for a 6% ΔT/T standard for NGSO FSS should be rejected as wholly inconsistent with ITU Recommendation S.1432. Qualcomm's arguments concerning the additional link power required by the primary service to overcome the 6% ΔT/T are well known facts that the ITU has already taken into account when deriving its 1% (not 6%) criterion. There is nothing unique about Qualcomm's proposed platform that justifies the

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[3] *See, e.g.*, Boeing Company Comments at 5-7; EchoStar Comments at 6-15; Gogo Comments at 18-19; SIA Comments at 7-19; ViaSat Comments at 4-7.

[4] *See* SIA Comments at 7-9.

Commission establishing service rules that would subject the primary service to such high levels of interference from a secondary service, in violation of long-established principles of the ITU. The fact that there are no NGSO FSS systems in operation today cannot justify a relaxation of the technical criteria for secondary services to protect primary services. Under ITU and Commission rules, secondary services must protect future primary services, not just existing ones.[5]

Moreover, as SIA, EchoStar/Hughes, ViaSat and Gogo have highlighted in this proceeding, there are significant concerns about the ability of Qualcomm's proposed AMS to adequately protect NGSO FSS systems in the 14.0-14.5 GHz band.[6] In these reply comments, SIA builds upon its previous analysis by recommending a possible EIRP density vs. elevation angle mask for AMS base stations for the protection of future NGSO systems. *See* Annex A. This, of course, would not preclude the possibility of future operational adjustments by secondary AMS licensees, if a future NGSO system were to receive unacceptable interference even under this mask.

Realistic G/T Values for GSO Satellite Receivers. In determining how the aggregate interference from a new secondary AMS can be kept below the 0.33% ΔT/T standard, the Commission must use realistic gain-over-temperature ("G/T") values for the FSS space station receivers. SIA has shown in its comments that the +2 dB/K value used in the NPRM analysis is too low, and that a more realistic G/T value is +6 dB/K. This value was derived from a survey of

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5 *See* 47 C.F.R. 2.104(d)(3); ITU Radio Regulations, Article 5.28-5.30.

6 *See, e.g.,* SIA Comments at 14-16; EchoStar Comments at 13 (stating that Qualcomm's proposed analysis "is woefully insufficient in ensuring that NGSO constellations can be operated with minimal interference from ATG licensees."); ViaSat Comments at 4 ("the configuration selected [by Qualcomm] is not illustrative of the types of NGSO systems that are likely to be deployed in the Ku band and does not reflect realistic operating parameters."); Gogo Comments at 19 (urging "further investigation of the potential for interference into (and from) NGSO systems in order to ensure that the rules for both NGSO and [AMS] systems provide a reasonable degree of certainty in the development of [AMS] systems.").

G/T information for FSS satellites authorized to serve the United States that SIA first submitted on October 12, 2012, and which was re-submitted with SIA's comments in response to the NPRM.[7] Qualcomm concedes that +2 dB/K is too low, and proposes instead a value of +4 dB/K.[8] However, Qualcomm's analysis ignores SIA's survey data of actual satellite receiver performance, and as a result its proposed G/T value is still unrealistically low when compared with the G/T data on file with the Commission.

A review of this data shows that the G/T of satellites can and do exceed +4 dB/K "on average" over the contiguous United States ("CONUS").[9] For example, the SES-2 satellite at 87° W.L. provides full CONUS coverage and has a peak G/T of just less than +8 dB/K. The contour maps filed for SES-2 show that virtually all of CONUS is within the -4 dB gain contour of the satellite receiver, *i.e.* the G/T exceeds +4 dB/K for virtually all of CONUS.[10] Even if Qualcomm's calculation methodology were used, the FCC-filed peak gain of the SES-2 antenna is 34.87 dBi—1.82 dB greater than the peak gain (at 100 percent efficiency) of 33.05 dBi assumed by Qualcomm in its calculations. Moreover, the SES-2 antenna gain includes the gain efficiency of the antenna, which Qualcomm assumed would reduce the theoretical gain by 0.97 dB. Taking these two factors into account would increase Qualcomm's calculated "average" G/T from +4.26 dB/K to +7.05 dB/K.[11] If the total FCC-filed system noise temperature of the SES-2 satellite (of 488° K) is also taken into consideration, it would result in Qualcomm's

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7 *See* Letter from Patricia Cooper, President, Satellite Industry Association to Marlene H. Dortch, Secretary, Federal Communications Commission, RM-11640 (filed Oct. 22, 2012); SIA Comments, Technical Annex at Appendix 1.

8 Qualcomm Comments at 25.

9 SIA Comments, Technical Annex at Appendix 1.

10 *See* IBFS File No. SAT-RPL-20110429-00082.

11 4.26 dB/K + 1.82 dB + 0.97 dB = 7.05 dB/K.

calculated average G/T increasing from +4.26 dB/K to +5.5 dB/K.[12] In any case, the calculated G/T is closer to the +6 dB/K value proposed by SIA than the +4 dB/K value now being proposed by Qualcomm.[13]

As a secondary service, the AMS must protect all satellites already authorized by the Commission—not simply some theoretical "average" satellite. This includes the full-CONUS SES-2, which demonstrably has a higher G/T over CONUS than the 4 dB/K assumed by Qualcomm. It should also include future satellites that may be at orbital positions to the east or west of CONUS and for which the geographic area of CONUS subtends a smaller solid angle from the satellite. As an example, a satellite located at 55° W.L. with a full CONUS beam will have approximately 2 dB more gain than one centered over CONUS. To ensure all authorized satellites are adequately protected, the Commission should carefully review the actual satellite data provided by satellite applicants as part of the satellite licensing process and consider future satellites at the full range of orbital locations that can serve significant portions of CONUS to determine an appropriate G/T factor for use in setting interference protection requirements.

Accordingly, to ensure there is adequate protection, the Commission should consider requiring an additional G/T margin of 3 to 5 dB to protect future satellites that may have higher gain receive beams—whether due to improved technology (*e.g.*, more efficient reflectors, more advanced feed arrays and low noise amplifiers) or different orbital positions—that result in even greater receive beam (G/T) performance over CONUS. Without such protections, satellite operators may have their incentives to innovate reduced, denying U.S. consumers the benefits of new satellite services.

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12 4.26 dB/K + 1.82 dB + 0.97 dB + 10Log(340°/488°) = 5.5 dB/K.

13 *See* SIA Comments at 10.

Aggregate and Individual Power Limits. Qualcomm,[14] the Commission,[15] and SIA[16] agree that individual and aggregate power limits on AMS aircraft terminals are necessary, but the limits proposed by Qualcomm and the Commission would be inadequate to protect either GSO or NGSO systems. First, the individual power limits proposed by the Commission and Qualcomm would apply only to aircraft terminals. Especially in light of Qualcomm's proposal to increase power to account for rain fade,[17] it is essential that the Commission apply an individual power limit to each base station. Additionally, for the reasons discussed above and in SIA's initial Comments, to provide adequate protection to GSO satellites, the limits should be calculated using the more realistic 0.33% $\Delta T/T$ and +6 dB/K criteria suggested by SIA.

As SIA also addressed in its initial Comments, further careful analysis of AMS aircraft to NGSO interference is required, because under certain assumptions, SIA's calculations suggest that interference from a single aircraft could result in up to at 0.91 percent $\Delta T/T$.[18] Absent much stricter protections, mitigation of aggregate interference to NGSO systems from all aircraft may not be possible.

Effective Monitoring and Enforcement. The record in this proceeding demonstrates that there are many variables to be considered and controlled, and numerous, difficult to isolate, factors that could contribute to interference to primary FSS operations by the proposed secondary AMS. As such, SIA reiterates that any rules developed for the protection of primary FSS must be capable of strict enforcement. Exactly how will compliance with individual and aggregate power limits be determined, monitored, and enforced? Exactly how will power

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14 Qualcomm Comments at 28-30.

15 NPRM, App. B (Proposed Rule Section 22.1120(b)).

16 SIA Comments, Technical Appendix at 17-22.

17 Qualcomm Comments at 30.

18 SIA Comments at 16-17, Technical Appendix at 23-26.

reductions necessary at various elevation angles be monitored? And how exactly would licensees manage the use of rain fade compensation by "powering down other beams" in the network, as Qualcomm suggests?[19] How would this be monitored or enforced by the Commission? These are not simple issues, and at the very least AMS operators should be required to keep detailed records of AMS base station and aircraft transmission, not dissimilar to those imposed on mobile applications of the FSS under the FCC's rules.[20] This record-keeping will assist the Commission in bringing an enforcement action and remedying any interference into the primary services should interference occur.

Conclusions. The record compiled in this proceeding reinforces the cautionary notes raised in SIA's initial Comments. Among the numerous important recommendations in the record, the Commission should impose a strict limit of 0.33% $\Delta T/T$ on secondary AMS, use a more realistic G/T value of +6 dB/K in determining interference protections, apply appropriate individual and aggregate power limits on both ground and aircraft AMS stations, and ensure that all of its rules enable effective monitoring and enforcement. As the Commission reviews this record, it should bear in mind the existing operational environment of the 14.0-14.5 GHz band, the need for protection of both GSO and NGSO FSS systems in this band, and the potential viability of secondary AMS in the band. Ultimately, should the Commission proceed to authorize secondary AMS operations in the 14.0-14.5 GHz band, it must take all steps necessary to ensure that AMS is a secondary operation and does not inhibit the current operations or future growth of FSS operations.

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19 Qualcomm Comments at 30.

20 *See e.g.*, 47 C.F.R. §§ 25.221(a)(5) and 25.222(a)(5) (requiring detailed record-keeping for ESVs); 47 C.F.R. § 25.226(a)(6) (requiring detailed record-keeping for VMEs); 47 C.F.R. § 25.227(a)(6) (requiring detailed record-keeping for ESAAs).

Respectfully submitted,

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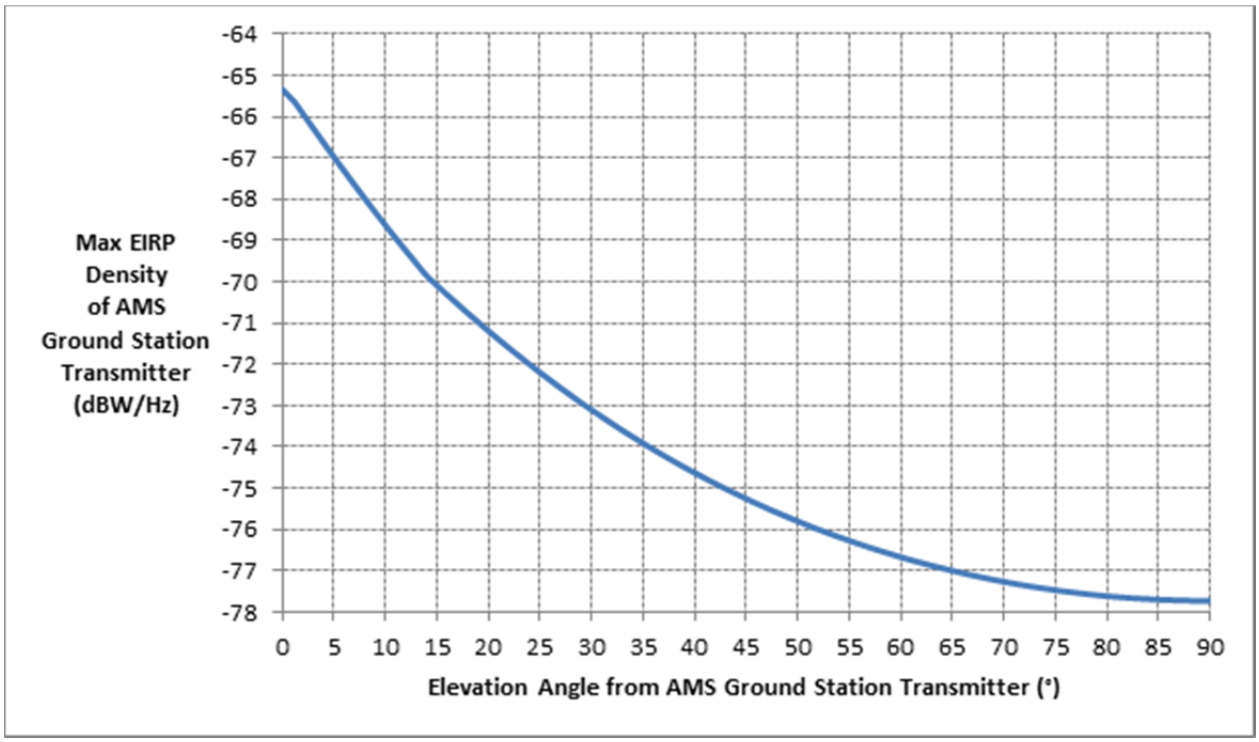
Annex A

Qualcomm has repeatedly asserted that the "isoflux" antenna of its AMS ground station transmitters will inherently protect NGSO satellites but Qualcomm has not been specific as to what range of elevation angles the antenna is indeed "isoflux" as far as a typical NGSO satellite constellation is concerned. Again in its most recent Comments to the NPRM Qualcomm has made only a vague reference to this.[21] This issue must be addressed in any FCC rule in order to ensure NGSO systems are adequately protected.

In SIA's Comments to the NPRM an analysis was provided for the case of the AMS ground station appearing at 1 degree elevation angle to the NGSO satellite. For Case C in that analysis the EIRP density of the AMS ground station would need to be limited to -65.59 dBW/Hz at 1 degree elevation. In Figure 1 below this analysis has been extended to all elevation angles and assumed to apply in all azimuth directions. As shown the EIRP density must reduce from approximately -65.4 dBW/Hz at zero elevation to -77.7 dBW at 90 degree elevation. This analysis assumes that, for elevation angles greater than 15 degrees (the assumed minimum operational elevation angle at which the NGSO system provides service), the peak of the NGSO satellite antenna is pointed towards the AMS ground station. A mask such as this must be included in the FCC rules in order to adequately protect primary NGSO satellite systems.

[21] *See* Qualcomm Comments at 32.

Figure 1: EIRP Density Limits for Each AMS Ground Station as a Function of Elevation Angle to Protect NGSO Systems (applicable to all azimuth directions)



CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING ENGINEERING INFORMATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in this supplement, that I am familiar with the Commission's rules, that I have either prepared or reviewed the engineering information submitted in this supplement and that it is complete and accurate to the best of my knowledge and belief.

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